

# SUPERCONDUCTIVE MAGNET INCLUDING A CRYOCOOLER COLDHEAD

## Abstract

A zero boiloff cryogen cooled recondensing superconducting magnet assembly including superconducting magnet coils suitable for magnetic resonance imaging including a cryogen pressure vessel to contain a liquid cryogen reservoir to provide cryogenic temperatures to the magnet coils for superconducting operation; a vacuum vessel surrounding the pressure vessel and spaced therefrom; a first thermal shield surrounding and spaced from the pressure vessel; a second thermal shield surrounding and spaced from the first thermal shield and intermediate the vacuum vessel and the first shield; a cryocooler thermally connected by a first and a second thermal interface to the first and second thermal shields, respectively; a recondenser positioned in the space between the pressure vessel and the first thermal shield and thermally connected by a thermal interface to the cryocooler to recondense, back to liquid, cryogen gas provided from the pressure vessel; and means for returning the recondensed liquid cryogen to the pressure vessel; wherein the second thermal shield surround-

ing the first thermal shield reduces a radiation heat load from the first thermal shield to the pressure vessel lowering boiloff of cryogen gas under conditions of failure or power off of the cryocooler.